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Subject: MMA development
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Memorandum

Date: June 13, 1997.

From: J.M.Payne.

To : Distribution

Subject: MMA development in Tucson.

Darrel has asked me to come up with a plan and a budget for the part of the initial MMA development that will be done in Tucson. I am working on this but there are several points that need clarification and I hope that this e-mail will provide a basis for discussion in the near future so that there is some agreement on the direction we are taking. The time scale for the work required is very short and I have assumed that delivery of the first antenna is in mid 99 and the second in the first quarter of 2000.

I am working on an estimate for the following:

1) Holography.

A holography receiver that will fit at the prime focus of the prototype antenna. The frequency of operation will be suitable for LES-9. It may be advisable to construct the receiver in such a way that changing frequencies is simplified as much as possible so that other satellites may be easily accommodated.

2) Nutating Sub-reflector

This will be provided on the first two antennas. It is undecided at present if this device will be needed on the final array. We need to address the following questions.

A) The final antenna geometry , the diameter of the sub-reflector and its mass(ie cfrp or aluminum).

B) The switching frequency. For the antenna evaluation at a US site a switching frequency of around 5Hz will be adequate. If we decide that the final array will need switching sub-reflectors then it may prove that, for the higher frequencies a faster rate is needed.

C)Do we need compensation to eliminate reaction forces on the feed support structure? The SMA uses compensation as does the 140 ft. The SMT dosn't and neither does the 12m. The use of a compensator complicates the design quite a bit.

D) For the evaluation do we need a calibration source in the center of the sub-reflector as we do on the 12m?

3)Sub-reflector Movement.

What are the magnitude and directions of the sub-reflector motions? Axial certainly and also elevation and probably not sideways.

4)The receiver.

Considering the time scales it will not be possible to outfit the prototype antennas with the final receiver(s). For the evaluation of the first antennas I feel that the objective must be to have reasonable receivers ready in time with as many features of the final receiver incorporated as possible. This implies ,of course a parallel development for the final receivers. Here are a few random thoughts on the prototype receivers.

A) Frequency Bands

There will be four frequency bands in the prototype receivers. A low frequency band somewhere in the 30- 40 Gigahz range, a 70-90 Gigahz HEMT, a 90-115 Gigahz SIS and a 200-300 Gigahz SIS. All bands would be dual polarization. Do we need to make all receivers ssb? This may be too ambitious and perhaps we should make the very first receiver 90-115 and 200-300 only. This would be more than adequate for the initial evaluation of the antenna and could use the inserts (" rockets") that are standard at the 12m. These prototype receivers will use one dewar equipped with a 4k J-T system identical to that used today at the 12m.

B) The dewar.

Lugten and Welch have proposed two dewars: a low frequency dewar for hemts at 15k and a high frequency dewar for SIS at 4k. Tony and I disagree with this concept and a couple of months ago we started a memo outlining our ideas. We then discovered an error in the off-axis analysis in the L\W memo and resolution of this has delayed our response. We favor one dewar for all bands. Tony and I should get this memo out as soon as possible in order to settle this question for the final array receivers but I feel that we need to move ahead with the prototype using one dewar. The antenna / receiver interface is vital and should be defined as soon as possible and although it might be possible to define it leaving the question of one or two dewars open this would be undesirable, in my opinion.

C)The cryogenics.

Again time will not permit development of a new 4k system for the prototype receivers. We should plan on replicating what we have for the prototype receiver but we should immediately start on a development program for the final array cryogenic system.(I understand that Larry will be starting on that very shortly). We should order the parts for the cryogenic system for the prototype receivers as soon as possible- three systems, giving one spare.

D) The input windows.

For mm and sub mm receivers this has been a bad problem in the past. All the materials that have low loss, are broad-band and are easy to fabricate have been leaky -usually resulting in a warm - up of the receiver after a few months. Tony has an idea for a new type of window that should alleviate this problem and the prototype receivers will provide a good opportunity for the evaluation of these new windows.

E) The Infra-red filters.

This is another area of development that can be pursued at the CDL. Our present filters are lossy and could be more effective. There are several alternatives that need to be looked into and again, Tony has good ideas on this.

F) The LO chain.

This is fairly difficult. We can make no assumptions about the laser lo system and the replication of the present system at the 12m may not be possible. We use a Carlstrom Gunn oscillator followed by either a Millitech multiplier or an NRAO multiplier. The future of the Carlstrom Co is uncertain; Millitech seems to be almost out of the multiplier business and NRAO stopped building multipliers as they were now available commercially from Millitech! We need to carefully review the situation and decide on a course of action. The fallback position may well be to rely on the spares at the 12m but I'm not too comfortable with that.

G) The IF and bandwidth

If we use the existing inserts we are stuck with an IF center frequency of 1.5 Gigahz and a bandwidth of 600 MHz which would be acceptable for the evaluation of the antenna but not acceptable for the initial interferometer tests which will require a center frequency somewhere in the range of 4- 12 Gigahz. What is our best plan for dealing with this?

5) Continuum Receiver

For the initial evaluation we will need a continuum system to be used with the nutating sub-reflector to measure aperture efficiency, pointing etc. The monitor and control system will use VME modules with VX-works as we do at the 12m and the sensible thing would seem to be to duplicate what we have.

6) Laser LO development.

There isnt too much to talk over here. I will be writing up a detailed plan for this project but I think that we are on track and I can do a detailed plan and budget fairly easily.

Perhaps we can fix up a teleconference fairly soon to discuss the matters raised here.